

MONITORING

**Adult/Juvenile Fish Community Monitoring
Fiscal Year 2003 Project Proposal**

Principal Investigators: Dale Ryden and Chuck McAda
U. S. Fish and Wildlife Service, Colorado River Fishery Project
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946
(970) 245-9319
dale_ryden@fws.gov

Background:

Studies performed before 1991 documented a native San Juan River fish fauna of eight species, including Colorado pikeminnow (previously known as Colorado squawfish), razorback sucker, and roundtail chub and provided baseline information on distribution and abundance of native and introduced fish species in the San Juan River. Main channel fish community monitoring studies (known as “adult monitoring”) performed from 1991 to 2001 refined this baseline data and provided data on specific habitat usage by rare fish species. Adult monitoring proved to be a highly effective tool for monitoring populations of stocked razorback sucker and Colorado pikeminnow. Information gathered during adult monitoring also aided in the selection of specific sites for detailed hydrologic measurements and larval drift sampling. Integration of adult monitoring data with data from Colorado pikeminnow macrohabitat studies, razorback sucker experimental stocking studies, tributary and secondary channel studies, fish health studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, helped provide data to make flow recommendations for reoperation of Navajo Reservoir.

Intensive electrofishing surveys conducted from 1991 to 2001 greatly expanded our knowledge on the distribution and abundance of the San Juan River fish community. As of October 2001, nineteen wild Colorado pikeminnow (two juveniles and 17 adults) have been collected and PIT-tagged; 13 of the 19 Colorado pikeminnow were radio-tagged. In addition, 15 adult and over 200 juvenile stocked Colorado pikeminnow have been recaptured (95 of these fish were captured on the October 1998 adult monitoring trip). Thirty-two roundtail chub were collected, 23 of these were PIT-tagged. No wild razorback sucker were collected, however over 100 recaptures (including multiple recaptures of individual fish) of stocked razorback sucker have occurred during adult monitoring trips. The 2002 adult monitoring trip is scheduled for late September through early October 2002. This trip is already funded via FY-2002 funds.

The need for a long-term, standardized monitoring program, such as the adult monitoring study, is addressed in objective 5.7.1, a Milestone in the San Juan River Long Range Plan. Additionally, future monitoring will help determine fish community response to reoperation flows from Navajo Dam (objective 5.2.10), as well as monitoring both wild and augmented populations of Colorado pikeminnow and razorback sucker (objective 5.3.9).

Adult monitoring will continue with one trip in fall 2003, to measure fish community response to reoperation flows from Navajo Dam, monitor populations of stocked Colorado pikeminnow and razorback sucker, and assess the impacts of management actions (e.g., nonnative fish removal efforts) on native fish species. In support of objective #4 below, nonnative fish removal will continue to be done on adult monitoring trips. The study design for adult monitoring is based upon the criteria for long-term monitoring of the San Juan River main channel fish community. These criteria were accepted as final by the San Juan River Biology Committee on 31 March 2000.

Description of Study Area:

The study area for adult monitoring extends from river mile (RM) 180.0 (Animas River confluence) in Farmington, New Mexico, downstream to RM 2.9 (Clay Hills Landing) just above Lake Powell in Utah. The entire reach of river from RM 180.0 to RM 2.9 will be sampled in the fall of every year (sampling to begin in the second to third week of September).

Objectives:

- 1.) Monitor the large-bodied species of the San Juan River fish community in order to determine shifts in community structure (e.g., abundance and distribution, length/weight frequencies) under the reoperation flow regime.
- 2.) Monitor wild Colorado pikeminnow population trends.
- 3.) Monitor experimentally stocked razorback sucker and Colorado pikeminnow (growth rates and dispersal patterns).
- 4.) Remove nonnative fish species which prey upon and compete with native fish species in the San Juan River.

Methods:

Objectives 1-5: One adult monitoring trip will take place in fall 2003. This trip will sample from the Animas River confluence in New Mexico (RM 180.0) to Clay Hills Landing in Utah (RM 2.9). Electrofishing will be the primary sampling technique, although seining and trammel netting may also be employed.

Two oar-powered rafts, with one netter each, will electrofish in a continuous downstream fashion, with one raft on each shoreline. No outboard motors will be used. Sampling crews will consist of approximately 8-9 people (4 for electrofishing, 2 for baggage rafts, and 2-3 for other research elements that are being done simultaneously with our sampling). Electrofishing will sample two out of every three miles (approximately 120 total sampled miles). All fish collected will be enumerated by species and life stage every sampled mile. Every fifth sampled mile (dubbed a "designated mile" or DM), all fish collected will be weighed and measured. All native fish collected will be returned alive to the river. All nonnative fish collected will be removed from the river. All predatory lacustrine fishes (i.e. - walleye, striped bass, largemouth bass,

smallmouth bass) collected will be weighed, measured, and have stomach contents taken, before being removed from the river. Tag numbers, total length, and weight will be recorded on all recaptured, FLOY-tagged fish (both native and nonnative), as well as any rare fish collected. Colorado pikeminnow, razorback sucker, and roundtail chub greater than 200 mm TL will be implanted with PIT (Passive Integrated Transponder) tags. Notes will be kept on any parasites and/or abnormalities observed on collected fishes.

Electrofishing will follow the methods set forth above and in the long-term monitoring plan. Seining and trammel netting may be done where suitable habitat is available at the sampling crews' discretion. The Service will have the lead for adult monitoring trips and other cooperating agencies will provide personnel and equipment as needed. Costs for cooperating agencies are included in this budget.

Products:

An interim progress report for adult monitoring data collected during 2003 is scheduled to be available by 31 March 2004. The “draft final” of this interim progress report which incorporates comments received, is scheduled to be completed by 1 June 2004. DBASE IV files containing information on total catch and length/weight data gathered on adult monitoring trips will be submitted to Keller-Bliesner Engineering for inclusion on the San Juan River Recovery Implementation Program integrated database CD-ROM by 31 March 2004.

Fiscal Year 2003 Budget:

Personnel

Objectives 1-4 (110 man days): logistics, electrofishing, removal of
nonnative fish

\$23,300

Subtotal

\$23,300

Travel and Per Diem (32 days)

\$ 6,750

Data Analysis and Reporting (45 days)

\$ 9,400

Subtotal

\$16,150

Equipment and Supplies--i.e., fuel and maintenance, repair, replacement of:

Field equipment: nets, PIT tag gear, rafts, generators, electrofishing
equipment, trucks, camping equipment, etc. ***

\$ 2,000

Total

\$41,450

Service Administrative Overhead (20.00%)

\$ 8,290

U.S. Fish and Wildlife-CRFP Total

\$49,740

Funding for participation of other agencies:

New Mexico Dept. of Game and Fish-Santa Fe

\$ 3,000

U.S. Fish and Wildlife Service-Albuquerque

\$ 3,000

Utah Division of Wildlife Resources-Moab

\$ 4,000

Subtotal

\$10,000**GRAND TOTAL****\$59,740**

*** The 'Equipment and Supplies' costs listed here represent the costs anticipated to be incurred by CRFP in FY-2003 for performing our own field work as well as providing equipment for other agencies (UDWR-Moab and USFWS-Albuquerque) with whom we are cooperating on approved SJRIP projects. Our total anticipated cost for 'Equipment and Supplies' in FY-2003 (i.e. \$6,000) has been divided evenly and distributed across three CRFP workplans, of which this workplan is one.

Previous Years' Funding:

Fiscal Year 1998 \$50,000

Fiscal Year 1999 \$43,900

Fiscal Year 2000 \$43,900

Fiscal Year 2001 \$54,400

Fiscal Year 2002 \$58,000

Estimated Outyear Funding (based on an annual 5% increase as agreed upon by the SJRIP Biology Committee at their 21 May 2002 meeting):

Fiscal Year 2004 \$62,750

Fiscal Year 2005 \$65,860

Fiscal Year 2006 \$69,150

Fiscal Year 2007 \$72,600

Fiscal Year 2008 \$77,700

YOY/Small Bodied Fish Monitoring Fiscal Year 2003 Project Proposal

Principal Investigators: David L. Propst and Amber L. Hobbes
Conservation Services Division
New Mexico Department of Game and Fish
State Capitol, Villagra Blvd., P.O. Box 25112
Santa Fe, NM 87504
(505 827-9906)

dpropst@state.nm.us ahobbes@state.nm.us

Background:

As set forth in Section 5.7 of the San Juan River Basin Recovery Implementation Program (SJRIIP) Long-Range Plan, a long-term monitoring program “to identify changes in the endangered and other native species populations, status, distributions and habitat conditions” was to be developed by the SJRIIP Biology Committee. The ichthyofaunal monitoring portion of the San Juan River Monitoring Plan and Protocols (Propst, et al., 2000) was divided into four primary areas, larval fish (drift sampling), larval fish (seining), young-of-year/small bodied, and subadult and adult/large-bodied fishes. The portion of the San Juan River to be monitored extends from the confluence of the Animas and San Juan rivers (Farmington) to Lake Powell (Clay Hills Crossing). The following work proposal for 2003 is to conduct the young-of-year/small-bodied fishes monitoring effort per protocols set forth in the San Juan River Monitoring Plan and Protocols (SJRMP).

In addition to accomplishing work (field, laboratory, data analysis, and report writing) specific to the young-of-year/small-bodied fish monitoring effort, NMGF personnel participate in telemetry studies, native-nonnative interaction study, and larval fish sampling of the San Juan River Basin Recovery Implementation Program. This work and budgeting for NMGF participation in these activities is included with Scopes of Work for each activity and submitted by Principal Investigator(s) for each.

Study Area:

The study area for YOY/small bodied fish monitoring extends from river mile RM 180.0 (Animas River confluence) in Farmington, New Mexico, downstream to RM 2.9 (Clay Hills Crossing) just above Lake Powell in Utah.

Collections:

Specimens collected will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in a sample or collection. All identifiable rare fish and all large-bodied native fish (i.e., flannelmouth and bluehead suckers) >150 mm TL will be released. All other specimens will be preserved in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory for identification, enumeration, and measurement (total length and mass).

Objectives:

The objectives of this portion of the San Juan River monitoring effort are to obtain data that will aid in the evaluation of the response (e.g., reproduction, recruitment, and growth) of native and nonnative fishes to different flow regimes and other management actions (e.g., impediment modification), track trends in species populations (e.g., abundance and relative condition) and characterize patterns of habitat use. The data will also be available to all researchers and may be used in conjunction with data obtained in other studies to evaluate future management activities.

Methods:

The study reach (Farmington to Clay Hills Crossing) includes geomorphic reaches 6 through 1, with Reach 1 being the most downstream. As stated in SJRMPP, sampling will occur every third mile within the study reach. Secondary channels are defined as channels having less than 25% of the volume of flow at the time of sampling and are at least 300 m in length. Inflow at the top of a channel is not necessary for it to be classified as a secondary channel. If any portion of a secondary channel (except mouth) is within a designated sample mile, the secondary channel will be sampled. Young-of-year/small-bodied fish monitoring will occur in conjunction with the large-bodied fish monitoring effort. All secondary channels in each third-mile will be sampled. Primary channel shoreline habitats will be sampled in 3-mile increments. Field work will be accomplished in autumn (late-September through mid-October) and involves one foray through each of three macro-reaches (Farmington-Shiprock, Shiprock-Four Corners, and Four Corners-Cray Hills Crossing).

Primary channel and secondary channel sampling sites will be within the same river mile. In addition to structured primary channel sampling, all backwaters and embayments ($>25 \text{ m}^2$) associated with the primary channel within each third-mile will be sampled.

Sample sites within secondary channels will be a sufficient distance from the inflow to and outflow from the secondary channel to minimize primary channel faunal and physiochemical influences. Secondary channel sample sites will be at least 100 and not more than 200 m in length.

All mesohabitats (e.g., pool, riffle, riffle-eddy, and shoal) within the site will be sampled in approximate proportion to their availability within the site; typically, at least five mesohabitat types will be sampled in each secondary channel. Each mesohabitat will be sampled separately with $3.2 \times 1.6 \text{ m}$ (4 mm mesh) drag seines. Each secondary channel sampling effort will be a minimum of 5 seine hauls. The number of seine hauls, total area (m^2) seined, and types of mesohabitats sampled will be recorded on standard field forms. Specimens collected in each mesohabitat will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in the seine. If a rare fish is captured, it will be identified, total length ($\pm 1.0 \text{ mm}$) and mass ($\pm 1.0 \text{ g}$) determined, and released. Any rare fish $>150 \text{ mm TL}$ will be scanned to determine presence of a PIT tag. If none is present, the specimen will be implanted with a PIT tag having a unique alphanumeric code. All pertinent data (i.e., total and standard lengths, mass, PIT tag code, mesohabitat, water depth, substrate, and cover) on rare fish captured will be recorded. All large-bodied native fish (i.e., flannelmouth and bluehead suckers) will be weighed, measured, and released. All other specimens will be preserved in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory for identification, enumeration, and measurement (total length and mass). Field collection number, habitat number, and river mile will be recorded on a water-proof label and placed in each specimen container. Location of site (UTM) will be determined with a GPS unit. Identification of all retained rare

fishes will be confirmed by personnel of the Museum of Southwestern Biology. Preserved specimens will be accessioned to the New Mexico Department of Game and Fish Collection of Fishes or the University of New Mexico Museum of Southwestern Biology.

Within each third-mile, shoreline habitats of the primary channel will be sampled. At each designated mile, all mesohabitats (e.g., riffle, debris pool, and shoal) along 200 m (near center of mile) of shoreline will be sampled. All mesohabitats present will be sampled in approximate proportion to their availability within the site. Regardless of the number of mesohabitats present at a primary channel site, at least 5 seine hauls will be made with a drag seine (3.2 x 1.6 m, 4 mm mesh). The shoreline (river right or left) sampled will be dependent upon accessibility of the shoreline. Where more than one shoreline is accessible (and can be seined efficiently), that with greater habitat diversity/complexity will be sampled. Location (UTM) will be determined with a GPS unit. Specimen and habitat data will be obtained and recorded as required for secondary channel sampling. All retained specimens from primary channel sampling will be preserved separately from the adjacent secondary channel collection. All retained specimens will be accessioned to the New Mexico Department of Game and Fish Collection of Fishes or the University of New Mexico Museum of Southwestern Biology.

Backwaters and embayments ($>25 \text{ m}^2$) not located within structured primary channel sampling sites also will be sampled. During periods of low flow, secondary channel mouths frequently function as backwaters or embayments. In this monitoring effort, secondary channel mouths without surface inflow from upstream will be treated as backwater/embayment habitat. The maximum number of backwaters or embayments sampled will be one per mile. Three seine hauls will be made in each backwater or embayment sampled. All specimens collected, except rare fishes, will be retained and returned to the laboratory for identification and enumeration. All rare fish will be measured and released; those $>150 \text{ mm}$ will be PIT tagged. Data collection and recording of relevant information (including GPS determined location) will be the same as for secondary and primary channels.

Ambient temperature and water quality data (water temperature, dissolved oxygen, conductivity, and salinity) will be measured in each sampled secondary channel, at primary channel sites and in backwaters/embayments. Secondary channel water quality data will be obtained a sufficient distance from the inflow to the secondary channel to minimize primary channel influences. All water quality data for each sample will be recorded on standard field forms.

Products:

Data collected during the 2003 monitoring effort will be summarized by geomorphic reaches. Minimally, the annual report will report density per species (number/ m^2) per geomorphic reach, size-structure of commonly-collected species populations by geomorphic reach, and rare fishes and the mesohabitats each was found in. Data obtained from secondary and primary channel sampling will be reported separately. Backwater and embayment data will be reported in the primary channel portion of the annual report. Community-comparison metrics, such as the Shannon-Wiener Index and Morisita's Index of Diversity, will be used for longitudinal and annual comparisons. River discharge data (Four Corners gage) will be used to assess the effect of discharge volume on species density estimates. All data obtained during 2003 monitoring activities will be electronically recorded in a format to be determined by the SJRIP Biology Committee. The annual report (including electronic database) will be submitted to the SJRIP Biology Committee by 31 March 2003.

Literature Cited:

Propst, D.L., S. P. Platania, D.W. Ryden, and R. Bliesner. 2000. San Juan River Monitoring Plan and Protocols. San Juan Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, NM.

Budget¹:

Young-of-year/small-bodied Monitoring (Field)	
Personnel (32 man days)	\$8,000
Travel and per diem	3,000
Specimen sorting and identification, specimen curation, and data compilation	
Personnel (64 man days)	16,000
Annual small-bodied/YOY data synthesis, analysis, and report preparation	
Personnel (40 man days)	10,000
Administrative Support (10 man days)	<u>2,000</u>
Subtotal	\$39,000
Report reviews and integration (e.g., annual & Long Range Plan) and meeting attendance (per diem only)	
Personnel (15 man days)	3,750
Travel and Per Diem	1,500
Administrative Support (5 man days)	<u>1,000</u>
Subtotal	\$6,250
 TOTAL	 \$45,250
Indirect Costs (10%)	<u>4,525</u>
 GRAND TOTAL	 \$49,775

¹Budget does not include in-kind contributions of about \$22,000 per year in salary and benefits. In-kind includes field time, data analysis and report preparation, meeting attendance, and administration.

Outyear Funding (based on 5% annual cost of living increases):

Fiscal Year 2000	\$57,200
Fiscal Year 2001	51,700
Fiscal Year 2002	51,700
Fiscal Year 2003	49,775
Fiscal Year 2004	52,275
Fiscal Year 2005	54,875
Fiscal Year 2006	57,625
Fiscal Year 2007	60,525

**San Juan River Colorado Pikeminnow Larval Fish Collecting Effort
Fiscal Year 2003 Project Proposal**

Principal Investigators: W. Howard Brandenburg and Michael A. Farrington
Division of Fishes - Museum of Southwestern Biology
University of New Mexico
Albuquerque, NM 87131
(505) 277-3218
whburg@unm.edu
mporter@unm.edu

and

Co-principal Investigator: David L. Propst
Conservation Services Program
New Mexico Department of Game and Fish
State Capitol, Villagra Bldg, P.O. Box 25112
Santa Fe, NM 87504
(505) 476-8103 dpropst@state.nm.us

Background:

Beginning in spring 1995, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico assumed responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, continued throughout 2001 with only minor changes in sampling protocol. Data collected from this research activity provided several discrete types of information on the fishes of the San Juan River. Data that can be obtained on the endangered fishes of the river include determining approximate spawning period, identifying approximate location of spawning sites, and assessing effects of annual hydrology (and temperature) on their reproductive activities. Similar data could also be obtained for other members of the ichthyofaunal community and contrasted with previously drift-net sampling to assess the effects of that year's flow regime on fish reproduction. Samples collected during this research program were processed and curated by Fish Division personnel at the University of New Mexico.

Between 1993-2000, a total of five larval Colorado pikeminnow were collected. The two YOY Colorado pikeminnow collected in 1993 (at Mexican Hat) were the same length (9.2 mm TL; MSB 18098, 18099) and were taken on consecutive days in late July (26-27). From these two individuals, we determined the date of spawning to be about 8-9 July 1995.

Two larval Colorado pikeminnow were taken at Mexican Hat during the 1995 larval fish passive drift-netting study. The first specimen, 9.5 mm TL mesolarvae (MSB 26187) was taken between 2114-2310 hours on 2 August 1995. The next morning (3 August 1995) between 0531-0800 hours, a second Colorado pikeminnow, 9.0 mm TL mesolarvae (MSB 26191) was collected. The similar size and developmental stage of these two individuals, in combination with the fact that the two fish were collected within 12 hours of each other, strongly suggest that they were cohorts from a spawning event. From these two individuals, a spawning date (between 15-17 July) was determined.

A single YOY Colorado pikeminnow was collected in 1996. That specimen was an 8.6 mm TL yolked-mesolarvae taken on 2 August 1996 in a drift net at the Mixer sampling locality (RM 128.0). That individual represents the only larval Colorado pikeminnow collected during drift net sampling at the Mixer. The 1996 back-calculated spawning date for Colorado pikeminnow (18 July 1996) was similar to that predicted in 1995 despite considerable difference in spring peak discharge (1995 - 12,100 cfs; 1996 - 3,450 cfs) and total annual discharge.

Table 1. Summary of larval and YOY Colorado pikeminnow collected in the San Juan River during larval drift-netting (1993-1998) and back-calculated dates of spawning.

Field Number	MSB Catalog Method Number	Number specimen.	Total	Date Length	Date Collected	River Spawned Mile	Sample
MH72693-2	18098	1	9.2	26 Jul 93	08 Jul 93	53.0	drift netting
MH72793-2	18099	1	9.2	27 Jul 93	09 Jul 93	53.0	drift netting
JPS95-205	26187	1	9.2	02 Aug 95	15 Jul 95	53.0	drift netting
JPS95-207	26191	1	9.0	03 Aug 95	17 Jul 95	53.0	drift netting
WHB96-037	29717	1	8.6	02 Aug 96	18 Jul 96	128.0	drift netting
TOTAL		5					

There have not been any additional non-stocked larval Colorado pikeminnow collected in the drift since August 1996. In 1998, less than 600 specimens were collected during a year replete with intense summer rainstorm events. These flushing flows transported considerable detritus into the river and overwhelmed drift collecting gear with debris. This excessive amount of debris required two years before all samples could be processed and fish separated from debris and identified. The sampling conducted in 1999 occurred during an extremely low flow year, which was reflected in the collection of a very limited number of drifting larval fish (only 84 at Four Corners and 79 at Mexican Hat). Conversely, 2000 was a more normal flow year resulting in the collection of over 2,100 specimens (1,370 at Four Corners and 768 at Mexican Hat). No Colorado pikeminnow were collected in drift studies during these years (1998-2000). Unfortunately, the 2001 sampling period was almost identical to that experienced in 1998 resulting in the collection of a massive amount of debris that will likely require two-years to process.

The limited number of wild adult San Juan River Colorado pikeminnow (versus stocked individuals) is reflective in the extremely low catch rate of larval Colorado pikeminnow. However, numerous adult and sub-adult pikeminnow have been stocked into the San Juan River over the last five years in an effort to augment the diminished population. The Colorado pikeminnow augmentation plan calls for continued stocking efforts in the San Juan River over the next 10 years. The Biology Research Team expects, as was documented with stocked razorback sucker, that reproduction among stock pikeminnow will occur and can be documented

through the sampling of larval fish. There are no means to differentiate between native versus stocked larval Colorado pikeminnow.

As the number of adult (reproductively mature) Colorado pikeminnow in the San Juan River increases (due to both stocking and recruitment), so does the probability of elevated levels of spawning by this species. The San Juan River Biology Committee charged us with exploring the possibility of expanding the sampling effort for larval Colorado pikeminnow in fiscal year 2003. One means of accomplishing this task was to include an additional sampling site in FY 2003 (increasing from two-to-three sites). Another suggestion for FY 2003 Colorado pikeminnow studies was to perform targeted sampling for pikeminnow similar to that being performed for larval razorback sucker. Collections targeting larval Colorado pikeminnow could be accomplished either by expanding the duration of the current larval razorback sucker survey (April-June) or through development of a discrete (new) project.

These and other items were considered and evaluated during the February 2002 San Juan River Biology Committee meeting. The team recommended the immediate by expansion of the larval razorback sucker survey (April-June) to encompass the months of June, July, and August with seining efforts to target sampling for Colorado pikeminnow. This change in sampling protocol required a deviation from the FY 2002 Scope of Work, was initiated July 2002 (using FY 2002 funds), and is proposed again for FY 2003.

Approval for this change in sampling was acquired at the 19-21 February 2002 San Juan River Biology Committee meeting in Farmington, New Mexico. The objectives of this specific monitoring effort are identified in the aforementioned document (1a, 3a, 3b) and listed below.

Study Area:

The principal sampling area for this study will be the San Juan River between Cudei Diversion Dam (near RM 142) and the Clay Hills boat landing (ca. RM 5) just above Lake Powell in Utah. This study will include acquiring collections in reaches of the San Juan River under the jurisdiction of the National Park Service.

Objectives:

- 1.) Determine the relative annual reproductive success of Colorado pikeminnow (1a)
- 2.) Provide annual summaries of monitoring results (3a)
- 3.) Provide detailed analysis of data collected to determine progress towards endangered species recovery in three years and thence every five years (3b).
- 4.) Provide comparative analysis of the reproductive success of San Juan River fishes
- 5.) Attempt to validate presumed spawning period of Colorado River pikeminnow

Methods:

Sampling for Colorado pikeminnow larvae will be conducted in the San Juan River between Cudei (RM 142) and Clay Hills (RM 2.9) from early July (ca. 1-10 July) through late-August (ca. 20-30 August). The tentative sampling schedule will be two trips per month. Access to the river and sampling localities will be acquired through the use an inflatable raft which will transport both personnel and collecting gear. There will not be a predetermined number of samples per

river mile or geomorphic reach for this study. Instead, an effort will be made to collect in as many suitable larval fish habitats as possible within the river reach being sampled.

As previous San Juan River investigations have clearly demonstrated that larval fish most frequently occur and are most abundant in low velocity habitats (i.e., isolated pools, backwaters, and secondary channels), sampling efforts will be concentrated in these mesohabitats. Small mesh seines (1 m x 1 m x 0.8 mm) will be the primary means of collecting larval fish from low-velocity habitats. Meso-habitat type, length, maximum depth, and substrate will be recorded for each sample. For seine samples, the length of each seine haul will be determined in addition to the number of seine hauls per site.

All retained specimens will be placed in plastic bags containing a solution of 5% buffered formalin and a tag inscribed with unique alpha-numeric code that will also be recorded on the field data sheet. River Mile, standardized for the San Juan River Basin Recovery Implementation Program, will be the primary descriptor used to designate the location of sampling sites. Global Positioning System (GPS) readings (the principal numeric descriptor) will be taken at each sampling locality as stipulated at the May, 2001 meeting of the San Juan River Biological Committee. Universal Transverse Mercator (UTM) coordinates and zone will be determined with a Garmin Navigation Geographic Positioning System Instrument for each sampling locality and recorded on a field data sheet whose unique alpha-numeric code matches that of the tag in the retained sample.

Preserved collections will be returned to the laboratory where they will be sorted, specimens identified to species, enumerated, measured (minimum and maximum size [mm SL] for each species at each site), transferred to 70% ethyl alcohol, and catalogued in the Division of Fishes of the Museum of Southwestern Biology (MSB) at the University of New Mexico (UNM). Specimens whose species-specific identity is dubious or merit additional verification will be forwarded to Darrel E. Snyder (Larval Fish Laboratory, Colorado State University) for review.

Catch per unit effort (CPUE), for each seine sample, will be determined as the number of fish per m² of water sampled. The annual 2003 larval Colorado pikeminnow survey report will present, in summarized tabular form, fish catch rate (per species) for the entire study period as well by river reach. In addition, catch rate between and within reaches will be compared temporally. Detailed collection information (i.e., catch methodology, species composition of the sample, mesohabitat description, physical-chemical habitat characteristics, length and developmental stage of Colorado pikeminnow specimens) will be provided for samples that contain larval Colorado pikeminnow.

Community-comparison metrics, such as the Shannon-Wiener Index and Morisita's Index of Diversity, will be used for longitudinal and annual comparisons. Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate overlaid with the annual hydrograph. Mean daily discharge data during the study period will be obtained from U.S. Geological Survey Gauges at Shiprock (# 09368000) of Four Corners (#09371010), New Mexico. These river discharge data will be used to assess the effect of discharge volume on species density estimates.

Products:

Draft reports for the 2003 larval Colorado pikeminnow sampling activities will be prepared and distributed by 31 March 2004 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2004. Fish collected from those studies will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program where the geo-referenced collection information will be maintained in a consistent database and GIS format. These data and any maps generated from them will be available to the San Juan River Biology Committee via hard-copy reports and electronically. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Budget FY-2003:

Personnel

Field Research Associate (55 staff-days) (sampling activities, collection management supervision, data entry, specimen identification)	\$ 16,500
Field Research Technicians (64 staff-days) (sampling activities, collection processing)	\$ 16,000
Subtotal	<hr/> \$ 32,500

Travel and per diem

Travel (mileage – 4WD – Alb to sites)	\$ 2,500
Field per diem (90 staff-days)	<hr/> \$ 4,500
Subtotal	\$ 7,000

Equipment and Supplies

Equipment repair and upkeep (trailer, drift nets, flow meters)	\$ 1,500
Sampling/Field Gear (flow meters, t-posts, storage materials)	\$ 1,500
Laboratory Equipment/supplies (fixatives,	\$ 800
Subtotal	<hr/> \$ 3,800
Total	\$ 43,300
Administrative Overhead	<hr/> \$ 6,500

GRAND TOTAL	\$ 49,800
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Out-year funding (based on 5% increases):

Fiscal Year 2001	\$ 35,834
Fiscal Year 2002	\$ 40,940
Fiscal Year 2003 *	\$ * 49,800
Fiscal Year 2004	\$ 53,000
Fiscal Year 2005	\$ 55,650
Fiscal Year 2006	\$ 58,430
Fiscal Year 2007	\$ 61,350

Reflects a redistribution of a portion of the sample processing costs from the Specimen Curation project to the larval Colorado pikeminnow research project.

**San Juan River Larval Razorback Sucker Survey
Fiscal Year 2003 Project Proposal**

Principal Investigators: Sara J. Gottlieb and W. Howard Brandenburg
Division of Fishes - Museum of Southwestern Biology
University of New Mexico
Albuquerque, NM 87131
(505) 277-6005 gottlieb@unm.edu
(505) 277-3218 whburg@unm.edu

and

Principal Investigators: David L. Propst
Conservation Services Program
New Mexico Department of Game and Fish
State Capitol, Villagra Bldg, P.O. Box 25112
Santa Fe, NM 87504
(505) 476-8103
dpropst@state.nm.us

Background:

In 1994, the first series of razorback sucker (n=672) were stocked in the San Juan River between Bluff, Utah and the Hogback, New Mexico. Mean length and mass of those individuals, at the time of stocking, was about 400 mm TL and 710 g, respectively. In 1995, 13 of the recaptured razorback sucker were tuberculate males and six of those individuals were ripe. Four recaptured 1995 razorback sucker were determined to be female but, unlike the males, none were sexually mature. In their 1995 report of activities, Ryden and Pfeifer (1996) suggested that the majority of the experimentally stocked San Juan River razorback sucker reached sexual maturity in 1995-96 and that spawning of these individuals might begin in the next two years.

The UNM-NMGF larval fish drift study, whose primary focus was determining spawning period, identifying approximate location of spawning sites, and assessing effects of annual hydrology (and temperature) on Colorado pikeminnow reproductive activities, provided similar information for other members of the ichthyofaunal community. At the November 1996 San Juan River Biology Committee integration meeting, it was suggested that a portion of the larval fish drift study be expanded to allow for documentation of razorback sucker spawning. However, because reproduction by razorback sucker (March-May) occurred considerably earlier than Colorado pikeminnow (June-July), separate investigations of spawning periodicity and magnitude were necessary for each species.

The most significant potential difference identified between the two studies, besides temporal differences in spawning, was that we were attempting to provide the first documentation of reproduction by individuals (razorback sucker) whose spawning potential had not been determined. Sampling for larval razorback sucker was being conducted with no assurance that the stocked population of adult razorback sucker would spawn in this system. Conversely, we knew from previous studies that Colorado pikeminnow reproduction had and was still occurring in the San Juan River and, because of this certainty, our larval fish sampling efforts for this minnow could be different than those for razorback sucker.

As numerous Upper Colorado River basin researchers had reported light-traps as one of the best means of collecting larval razorback sucker, we too elected to use that sampling procedure during the first year (calendar year 1997) of sampling. The only previous San Juan River fish investigation that employed light-traps was in 1994-1995 (conducted by the National Park Service) near the San Juan River-Lake Powell confluence. The 1994 sampling effort produced an extremely large number of larval fish (ca. 25,000) from a modest number of samples (n=20), of which over 99% were red shiner. Similar sampling in 1995 yielded 25,455 specimens in 47 light-traps samples and as in 1994, red shiner numerically dominated the catch. No Colorado pikeminnow or razorback sucker were taken in the 1994-1995 light-trap sampling efforts.

During the 1997 razorback sucker larval fish survey, light traps were set nightly in low-velocity habitats between Aneth and Mexican Hat from late March through mid-June 1997. The traps were distributed at dusk and retrieved about four hours later. Fish taken in those samples were preserved in the field. Sampling success during the 1997 razorback sucker larval fish study was quite poor. While there were over 200 light-trap sets, those sampling efforts produced only 297 fish. Of those, about 200 (66%) were larval suckers (either flannelmouth sucker or bluehead sucker). Larval razorback sucker were not present in the 1997 sampling survey. While there were probably several factors to account for the poor light trap catch rate, a principal factor was the limited access to suitable habitats. Light traps are most effective when set in habitats with little or no water velocity. During our driving survey of riverine habitats in the region (March 1997), we identified numerous locations that appeared to be suitable sites for light trap sampling. However, we found that high flow in the San Juan River eliminated virtually all previously identified low velocity habitats. Further driving reconnaissance failed to yield additional locations to set light traps. Being tied to specific collecting sites was not the most efficient means of collecting large numbers of individuals.

In 1998 we modified our sampling technique to allow for the sampling of a greater portion of the San Juan River and the collection of a significantly larger number of larval fish over a wider reach of the river. We conducted sampling forays (n=6) at approximately bi-weekly intervals from 17 April (first trip - no larval suckers) to 6 June 1998 between the Four Corners drift-net station (RM 128) and Bluff (RM 80) and used both active and passive sampling techniques to collect larval fish. The primary sampling method was a fine mesh larval seine (in 1998, we collected more larval sucker in a single seine sample than in all of the 1997 light trap samples). Passive sampling techniques were both drift-netting and the use of light-traps. Drift-nets were set periodically to determine if larval sucker comprised a significant portion of the drift community while light-traps were set adjacent to campsites if appropriate aquatic mesohabitats could be located. An inflatable raft was used to traverse this river reach and allow investigators the opportunity to sample habitats that were either not formerly accessible or observable under the constraints of the previous sampling protocol.

The 1998 sampling protocol resulted in 183 collections and 13,000 specimens between river miles 68.7 and 126.1. The majority of these individuals (n=9,960) were larval catostomids. This 43-fold increase in number of specimens, as compared with 1997, provided substantially better resolution of spawning periodicity of the sucker community. In addition, the 1998 samples produced enough individuals for investigators to determine, with a high degree of confidence, if razorback sucker reproduction occurred in the San Juan River during that period. None of the aforementioned information was obtainable from 1997 light-trap samples. In 1998, two larval razorback sucker were collected. These specimens provide verification of spawning by the re-established population.

In 1999, the study area was expanded to include the San Juan River from near Four Corners (River Mile 128) to near Clay Hills (River Mile 4.9). The scope of work for that year included at least one collecting effort between Sand Island and Clay Hills. A total of 174 fish collections were made in 1999 producing over 20,000 fishes. Over 37% of these individuals were sucker larvae ($n=7,635$). Seven larval razorback sucker were collected in 1999 between 4 May and 14 June. The seven larvae (razorback) were taken in backwater or low velocity habitats located between river miles 96.2 and 11.5. Almost half ($n=3$) of these individuals were in the new-downstream reach first sampled in 1999.

There was no substantive change in the sampling protocol or methodology for this project in 2000. A total of 210 collections were made between 4 April and 23 June 2000. These collections yielded 11,316 specimens of which 7,587 (67%) were larval sucker. There was a marked increase in the number of larval razorback sucker taken in 2000 as compared with 1999 and 1998. Identifications verified by Darrel E. Snyder (Colorado State University) revealed 138 larval razorback sucker in 24 separate collections. Individuals were collected in low velocity habitats between river miles 124.8 and 8.1. The lowest-most sampling location that yielded larval razorback sucker (RM 8.1) produced over 85 individuals in a single sample (26 May 2000). Conversely, the uppermost collection of larval razorback sucker was less than four river miles downstream of the upper boundary of the study area on 1 June 2000.

Likewise, there was no substantive change in the sampling protocol or methodology for this project in 2001. The 206 fish collections made between April and June 2001 yielded 96,590 specimens of which 42 were larval razorback sucker. Larval red shiner were much more prevalent in 2001 collections than during the previous year's sampling events comprising almost 88% ($n=84,679$) of the 2001 catch.

The results of this investigation suggest continued recruitment of adult reproductively mature razorback sucker to the population. The logarithmically increasing trend in the number of razorback sucker larval collected between 1998 and 2000 was not continued into 2001. That fewer larval razorback sucker were collected in 2001 should not be interpreted until collections from 2002 (and 2003) have been made, processed, and analyzed. Regardless of any change in larval razorback sucker catch rate between 2000 and 2001, the sampling process has proven an extremely effective means of monitoring this ontogenetic stage of this species.

This work is being conducted as required by the San Juan River Basin Recovery Implementation Program Monitoring Plan and Protocol dated 31 March 2000. The objectives of this specific monitoring effort are identified in the aforementioned document (1a, 3a, 3b).

Study Area:

Beginning in FY 2002 sampling was expanded (upstream) to include an additional 14 river miles of the San Juan River (the reach between Cudei Diversion Dam and RM 128). The principal sampling area for this study will remain the San Juan River between Cudei Diversion Dam (near RM 142) and the Clay Hills boat landing (ca. RM 5) just above Lake Powell in Utah. As in all post 1999 sampling efforts, the study will include making collections in reaches of the San Juan River under the jurisdiction of the National Park Service.

Objectives:

- 1.) Determine the spawning periodicity of razorback sucker between early-April and late-June and examine potential correlations with water temperature and river discharge.
- 2.) Attempt to validate presumed spawning period of razorback sucker using data from the razorback sucker and Colorado pikeminnow larval fish studies.
- 3.) Determine if reproduction by razorback sucker occurred in the San Juan River (upstream of Mexican Hat, UT)
- 4.) Provide comparative analysis of the reproductive effort of catostomids.
- 5.) Determine the relative annual reproductive success of razorback sucker (1a)

Methods:

Sampling for razorback sucker larvae will be conducted in the San Juan River between Cudei (RM 142) and Clay Hills (RM 2.9) from early April (ca. 1-10 April) through late-June (ca. 20-30 June). The tentative sampling schedule will be two trips per month. Access to the river and sampling localities will be acquired through the use of an inflatable raft which will transport both personnel and collecting gear. There will not be a predetermined number of samples per river mile or geomorphic reach for this study. Instead, an effort will be made to collect in as many suitable larval fish habitats as possible within the river reach being sampled.

As previous San Juan River investigations have clearly demonstrated that larval fish most frequently occur and are most abundant in low velocity habitats (i.e., isolated pools, backwaters, and secondary channels), sampling efforts will be concentrated in these mesohabitats. Small mesh seines (1 m x 1 m x 0.8 mm) will be the primary means of collecting larval fish from low-velocity habitats. In addition, light-traps will be employed when appropriate aquatic low-velocity mesohabitats can be located adjacent to that evening's campsite. Meso-habitat type, length, maximum depth, and substrate will be recorded for each sample. For seine samples, the length of each seine haul will be determined in addition to the number of seine hauls per site. The aforementioned habitat conditions will also be recorded at light-trap sampling sites in addition to the time of placement, time of retrieval, and duration of the light-trap sample.

All retained specimens will be placed in plastic bags containing a solution of 5% buffered formalin and a tag inscribed with unique alpha-numeric code that will also be recorded on the field data sheet. River Mile, standardized for the San Juan River Basin Recovery Implementation Program, will be the primary descriptor used to designate the location of sampling sites. Global Positioning System (GPS) readings (the principal numeric descriptor) will be taken at each sampling locality as stipulated at the May, 2001 meeting of the San Juan River Biological Committee. Universal Transverse Mercator (UTM) coordinates and zone will be determined with a Garmin Navigation Geographic Positioning System Instrument for each sampling locality and recorded on a field data sheet whose unique alpha-numeric code matches that of the tag in the retained sample.

Preserved collections will be returned to the laboratory where they will be sorted, specimens identified to species, enumerated, measured (minimum and maximum size [mm SL] for each species at each site), transferred to 70% ethyl alcohol, and catalogued in the Division of Fishes of the Museum of Southwestern Biology (MSB) at the University of New Mexico (UNM).

Specimens whose species-specific identity is dubious or merit additional verification will be forwarded to Darrel E. Snyder (Larval Fish Laboratory, Colorado State University) for review.

Catch per unit effort (CPUE), for each seine sample, will be determined as the number of fish per m² of water sampled. The number of fish collected per hour that light-traps are set will be presented as CPUE for this collecting methodology. The annual 2003 razorback sucker survey report will present, in summarized tabular form, fish catch rate (per species) for the entire study period as well by river reach. In addition, catch rate between and within reaches will be compared temporally. Detailed collection information (i.e., catch methodology, species composition of the sample, mesohabitat description, physical-chemical habitat characteristics, length and developmental stage of razorback sucker specimens) will be provided for samples that contain larval razorback sucker.

Community-comparison metrics, such as the Shannon-Wiener Index and Morisita's Index of Diversity, will be used for longitudinal and annual comparisons. Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate overlaid with the annual hydrograph. Mean daily discharge data during the study period will be obtained from U.S. Geological Survey Gauges at Shiprock (# 09368000) of Four Corners (#09371010), New Mexico. These river discharge data will be used to assess the effect of discharge volume on species density estimates.

Products:

A draft report for the 2003 razorback sucker sampling activities will be prepared and distributed to the San Juan River Biology Committee for review by 31 March 2004. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2004. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program where the geo-referenced collection information will be maintained in a consistent database and GIS format. These data and any maps generated from them will be available to the San Juan River Biology Committee via hard-copy reports and electronically. Electronic copies of the field and collection data will be transferred to the San Juan River database manager.

Budget FY-2003:

Personnel

Field Research Associate (65 staff-days) (sampling activities, collection management supervision, data entry, sample processing)	19,500	\$
Field Research Technicians (48 staff-days) (sampling activities, collection processing)	12,500	\$
Subtotal	\$ 32,000	

Travel and per diem

Travel (mileage, shuttle costs, vehicle storage)	\$ 2,500	\$ 1,500
Field per diem (33 staff-days)	\$ 600	
Non-Field per diem (6 staff-days)		
Subtotal	\$ 4,600	

Equipment and Supplies

Rafting Equipment maintenance/upkeep	\$ 2,000	
Sampling/Field Gear	\$ 500	
Laboratory Equipment/supplies (fixatives,	\$ 600	
Subtotal	\$ 3,100	
Total	\$ 39,700	
Administrative Overhead	\$ 5,950	

GRAND TOTAL **\$ 45,650**

Out-year funding (based on 5% increases):

Fiscal Year 2001	\$ 21,965
Fiscal Year 2002	\$ 38,525
Fiscal Year 2003 *	\$ *45,650
Fiscal Year 2004	\$ 50,330
Fiscal Year 2005	\$ 52,850
Fiscal Year 2006	\$ 55,500
Fiscal Year 2007	\$ 58,275

Reflects a redistribution of a portion of the sample processing costs from the Specimen Curation project to the larval razorback sucker research project.

San Juan River Specimen Curation Fiscal Year 2003 Project Proposal

Principal Investigators: Alexandra M. Snyder and Thomas F. Turner
Division of Fishes - Museum of Southwestern Biology
University of New Mexico,
Albuquerque, NM 87131
(505) 277-6005
amsnyder@unm.edu
turnert@unm.edu

Background:

Personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico are responsible for two inter-related programs on the San Juan River. The Fish Division is the repository for specimens collected and retained by researchers. Fish taken under these programs are initially sorted by the principal investigator, held until they have submitted their yearly-progress report, and then received by MSB personnel. The collection is accessioned, specimens transferred from formalin to alcohol, identifications verified, individuals enumerated, length ranges recorded (largest and smallest specimen in a collection), collection data verified and transferred to wet labels, and incorporated into a database. It is standard policy at all major Natural History museums (i.e., Smithsonian Institution, Carnegie Museum, University of Michigan Museum of Zoology) that, prior to incorporation into the collection, all specimens be examined by qualified personnel (in that particular field of study) in an effort to verify the original identification and collection information. This system provides a final check (safeguard mechanism) to minimize the likelihood of misidentification of San Juan River fish species with particular attention on Colorado pikeminnow and razorback sucker. Any changes in species identifications that are detected are noted and returned to the principal investigator along with the entire data set (listing of collection locality, collectors, date, original field number, species, number of specimens, length ranges, and museum catalog number).

In addition to performing duties associated with collections curation, we are also responsible for complete processing (sorting, identifying, counting, curating, and reporting) of selected San Juan River collections (Colorado pikeminnow larval fish sampling and razorback sucker larval fish sampling). The samples generated by the aforementioned studies resulted in the collection of over 20,000 larval fish during 1999, 15,000 during 2000, and 96,000 during 2001. In 1999 and 2001, we processed almost 200,000 larval and juvenile fishes collected by the New Mexico Department of Game and Fish and Utah Division of Wildlife Resources. As in the past, deviations in the identifications of those samples have been noted and forwarded to the principal investigators. All of the non-MSB samples from calendar year 2001 have been received and are being processed by MSB personnel.

The number of fish processed by the MSB Division of Fishes under the San Juan River Recovery Program can fluctuate greatly between years. One reason for the vacillation in number of specimens is because the samples sent to MSB by non-MSB researchers are not processed until almost one year following their collection. This lag between time of

collection and MSB processing is necessary as individual researchers must perform the preliminary sort and require the specimens for preparation of their reports. Other factors such as annual variability of sampling conditions and initiation of new or completion of old projects has resulted in marked changes in the number of samples and specimens (As occurred between 2001 and 2002 when drift sampling for larval Colorado pikeminnow was eliminated in favor of seine sampling).

Discussion of this issue with the San Juan River Biology Committee resulted in the recommendation that the annual budget for the San Juan River Specimen Curation and Larval Fish Identification reflect an “average” year of sample processing. The Biology Committee recognized that some years would require more effort from MSB than budgeted while other years might not require the same high level of activity. A relatively stable budget allowed for uninterrupted processing of samples and was sufficient to allow the processing of backlogged samples generated during years of exceptionally high fish capture. To date, over 750,000 specimens (along with associated locality and ecological data) have been curated into the MSB Division of Fish Collection and are available to researchers

Almost all MSB-San Juan River Basin achieved samples are the result of collections made under the San Juan River Basin Recovery Implementation Program Monitoring Plan and Protocol. In addition, a component of New Mexico Department of Game and Fish collecting permits is the disposition of all retained specimens in the Museum of Southwestern Biology for curation.

Study Area:

This project does not involve the collection of specimens but instead the processing and curation of samples gathered by the different research components of the San Juan River Research program. The collective sampling area for other researchers will be the San Juan River between the outfall of Navajo Reservoir and the Clay Hills boat landing (RM 2.9) just above Lake Powell in Utah.

Objectives:

- 1.) Provide a permanent repository for San Juan River fish collections, field notes, and associated data
- 2.) Verify species identifications, enumerate specimens, and report to principal investigators
- 3.) Maintain a GIS reference database for current material
- 4.) Assist principal investigators with secondary collection sorting and identifications as time and resources permit

Methods:

The primary task to be completed under this project is the processing and curation of fish specimens generated by research projects executed under the auspices of the San Juan River Recovery Implementation Program. Samples are transferred to the Division of Fishes, by the principal investigator of a project, once that individual has completed their work and prepared the necessary reports. (This usually infers a lag-time of one year

between collection of specimens and transference to the Division of Fishes). Collections are matched with the appropriate data-sheet, transferred from formalin to alcohol, stored in museum quality jars, re-identified, counted, measured (range), labeled, and catalogued into the permanent MSB Fish Division collection and placed on the shelves in the light and temperature controlled collection room. All data associated with the specimens are entered into the database of the Division of Fishes and subsequently copied to the San Juan River database.

In addition to the aforementioned responsibilities, the Division of Fishes is available and has frequently assisted principal investigators by taking on the added responsibility of processing (a limited number) of their unsorted collections (without requesting additional funding). Specimens are sorted, identified, counted, measured, catalogued, and data submitted to the principal investigator for inclusion in reports. In cases where the amount of backlogged material in the possession of the principal investigator was beyond our capabilities, supplemental funds have been sought so that additional personnel can be hired (under the supervision of the permanent staff) to process the excess material.

Products:

A draft report of the 2003 San Juan River specimen curation and larval fish identification sampling activities will be prepared and distributed by 31 March 2004 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2004. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Budget FY-2003:

Personnel

Research Associate (36 staff-days) (final verification of all specimens, data compilation, data entry and management, supervision)	\$ 12,600
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Subtotal	\$ 19,800
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Travel and per diem

Travel (airlines, mileage –2 trips)	\$ 700
Per diem (6 staff-days)	\$ 500

Subtotal	\$ 1,200
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Equipment and Supplies

Laboratory Equipment/supplies (vials, jars, alcohol, acid-free labels)	\$ 2,000
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Computer supplies/maintenance	\$ 1,000
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Subtotal	\$ 3,000
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24,00

GRAND TOTAL	\$ 27,600
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Out-year funding (based on 5% increases):

Fiscal Year 2001	\$ 35,938
Fiscal Year 2002	\$ 38,755
Fiscal Year 2003 *	\$ * 27,600
Fiscal Year 2004	\$ 28,980
Fiscal Year 2005	\$ 30,429
Fiscal Year 2006	\$ 31,950
Fiscal Year 2007	\$ 33,550

Reflects a redistribution of a portion of the sample processing costs to the larval Colorado pikeminnow and larval razorback sucker research projects.

Long Term Monitoring - Channel Morphology Fiscal Year 2003 Project Proposal

Principal Investigator: Ron Bliesner
Keller-Bliesner Engineering
78 East Center, Logan, UT 84321
(435) 753-5651 bliesner@kelbli.com

Study Area:

The study area consists of the San Juan River and its flood plain from RM 180 (Farmington, NM) to RM 3 (Clay Hills Crossing).

Collections:

There are no collections associated with this study.

Background:

There are presently 25 river transects that have been established between RM 180 and RM 3 in the San Juan River for purposes of measuring channel scour and deposition. Additionally, substrate composition (sand or cobble/gravel) has been identified during each survey. These cross-sections have been surveyed before and after runoff since 1992. The data from these surveys was used to examine channel scour and deposition, determine change in channel capacity and track change in substrate material. Flow statistics for 8,000 cfs flows were based, in part, on these data.

Maintenance of cobble bars with open interstitial space has been determined to be important for spawning of Colorado Pikeminnow. Four of the sites (RM 173.7, 168.4, 132, 131) that have been identified in the San Juan River as having characteristics suitable for spawning have been monitored since 1995. The results of the surveys at this site were used as part of the basis of the flow recommendation at 8,000 cfs. To verify or adjust this recommendation, these sites will continue to be monitored.

The flow-habitat area model for backwaters is based on the ability of the channel to clean sediment from the system and the rate at which the sediment accumulates in the backwaters after runoff. The amount of perturbation (loss of habitat) due to summer and fall storms has been estimated based on analysis of habitat area data collected before and after storm events. Equivalent data on change in depth of backwaters and depth of sediment have not been analyzed. It is proposed that sediment depth and water depth be measured in backwaters twice yearly at the end of runoff in late July or early August and again in October to assess change. The second sampling will be completed during the fall habitat mapping exercise.

Objectives:

- 1.) River Geometry Monitoring. Determine short term and long term change in river cross sections at key locations and the relationship of this change to spring runoff and summer/fall storm events.

- 2.) Cobble Bar Monitoring. Determine short term and long term change in cobble bar characteristics in response to spring runoff and summer/fall storm events.
- 3.) Backwater Perturbation Monitoring. Monitor effect of spring runoff and summer/fall storm events on sediment accumulation in backwaters and backwater depth.

Methods:

- 1.) River Geometry Monitoring. The 14 cross-sections identified in 1999 as part of the long term monitoring plan will be surveyed pre- and post-runoff for analysis of annual change and compared to previous surveys to determine trends. Analysis of the change in cross-section geometry and substrate in relation to hydrographic conditions will be completed to monitor response of the system to flow recommendations.
- 2.) Suspended Sediment Analysis. Continuous turbidity monitors are installed at Shiprock, New Mexico and Montezuma Creek Bridge, Utah. The data will be used to qualitatively assess sediment transport in relation to the flow regime, in addition to identification of storm events.
- 3.) Cobble Bar Monitoring. Maintenance of cobble bars with open interstitial space has been determined to be important for spawning of Colorado Pikeminnow. Four sites (RM 173.7, 168.4, 132, 131) have been identified in the San Juan River as having characteristics suitable for spawning. These sites have been monitored since 1995. The results of the surveys at this site were used as part of the basis of the flow recommendation at 8,000 cfs. To verify or adjust this recommendation, these sites will continue to be monitored per the long range monitoring plan.

Topographic surveys will be completed for each of the sites utilizing total station or gps survey equipment with control provided by the established bench marks at each site. Surveys will be completed as soon as practical after spring runoff, usually during the end of July or early August. The same area will be surveyed each year to allow comparison to previous years.

At the same time, the structure of the bar will be assessed by completing point counts of the surface bed material (n=200 per sample or more) at each bar. Particles will be selected by the point count method over the full extent of the bar within the survey boundary. Size is determined by placing the rocks through a square hole in an aluminum plate, cut to represent an equivalent screen size from 1 cm through 10 cm at 1 cm increments, then 2 cm increments through 20 cm. Those larger than 20 cm are recorded as greater than 20 cm. Interstitial material smaller than 1 cm is not recorded.

Depth of open interstitial space (depth to embeddedness) will be measured on a 5 or 10-ft grid over the extend of the bar. Measurement will be made by working a hand between rocks until the fingers touch the sand embedded depth. The depth

of penetration below the average top of cobble immediately adjacent to the sample point will be measured and recorded as the depth of open interstitial space.

Change in bar morphology will be determined by producing three-dimensional plots of the surveyed surface and subtracting the resulting surface from the surface generated from the previous survey. The amount of change will be correlated to the flow conditions for the year.

The size distribution of cobble at each bar is computed and the D_{16} , D_{50} and D_{84} sizes reported and compared to previous years. Depth of open interstitial space will be computed as actual depth and multiples of mean cobble diameter.

- 4.) Backwater Perturbation Monitoring. To characterize the relative quality of backwaters, five representative backwaters within each geomorphic reach will be measured for water and sediment depth. Measurements will be made annually between September 15 and Nov 1 per the long term monitoring plan. These sites will remain the same from year-to-year to the extent possible. If a backwater is “lost,” another will be selected for sampling and retained in the sampling regime until it is lost. Depth of sediment will be measured and recorded for “lost” backwaters. All measurements will be made at flows between 500 and 1,000 cfs, if possible, and at the same flow from year-to-year, if possible. Sediment and water depths will be measured at three points in each backwater (mouth, 1/3 and 2/3 of length). The backwaters sampled will be marked on digital aerial imagery.

Storm events will be determined by changes in flow and turbidity at USGS gages located near Shiprock and Montezuma Creek.

The annual report will include a summary of backwater measurement data for each site, including site location, water and sediment depth, flow at sampling, flow and turbidity data. Every five years the runoff/storm event/backwater habitat relationships will be analyzed.

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task. The annual report will include a summary of backwater measurement data for

each site, including site location, water and sediment depth, flow at sampling, flow and turbidity data.

The draft progress report and data submittal to the database are due 31 March 2004. Final report is due 1 June 2004.

Budget FY-2003:

Category	Staff-Days	Cost
Personnel:		
Coordination & report	38	\$ 25,680
Cross-section survey	37	\$ 24,896
Spawning bar monitoring	34	\$ 22,351
Backwater perturbation monitoring	<u>29</u>	\$ 18,380
Subtotal	138	\$ 91,307
Travel/per diem:		
Data analysis & report	0	\$ 0
Cross-section survey	30	\$ 2,960
Spawning bar monitoring	18	\$ 3,860
Backwater perturbation monitoring	<u>21</u>	\$ 4,275
Subtotal	69	\$ 11,095
Equipment Rental (boats, survey inst.)		\$ 1,430
Misc. supplies, copies, etc.		\$ 2,013
Overhead (10% of subcontract)		\$ <u>1,324</u>
Grand Total		\$ 107,169

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

Habitat Mapping
Fiscal Year 2003 Project Proposal
Principal Investigator: Ron Bliesner
Keller-Bliesner Engineering
78 East Center, Logan, UT 84321
(435) 753-5651 bliesner@kelbli.com

and

Principal Investigator: Vince Lamarra
Ecosystems Research Institute
975 South State Highway, Logan, UT 84321
(435) 752-2580 vincel@ecosysres.com

Study Area:

The study area consists of the San Juan River from RM 180 (Farmington, NM) to RM 3 (Clay Hills Crossing).

Collections:

There are no collections associated with this study.

Background:

Habitat mapping completed during the period 1992 - 1997 has been used to develop flow/habitat relationships used in the flow recommendation process. To verify and refine these relationships and examine long term trends, habitat mapping will be continued on an annual basis during the low flow period in the fall per the long range plan.

Objectives:

- 1.) Main River Habitat Mapping. Map San Juan River habitat from RM 180 to RM 0 during September-October. This objective is a continuation of the 2000 work as described in the long term monitoring program.
- 2.) Digitize and process data utilizing GIS. Habitat mapping data will be digitized and entered into the ArcCAD system.

Methods:

- 1.) Habitat mapping (San Juan River). One flight to collect digital aerial photography or videography will be completed for the San Juan River from RM 180 to RM 0 and printed at an approximate scale of 200 ft/inch. Thirty-eight categories of aquatic habitat will be mapped in the field utilizing the digital imagery as a base map. The flights and mapping will be completed as soon after runoff as flows reach 1,000 cfs or

less and weather will allow. Field mapping will be completed at flows between 500 and 1,000 cfs if possible.

Two of every three miles will be mapped through the full reach, corresponding with the miles designated for sampling under the other long term monitoring plans.

- 2.) Digitize and process data utilizing GIS. Upon completion of each habitat mapping program (Objectives 1 and 2), the field maps will be rectified and digitized into ArcCAD.

Products:

An annual report and GIS coverages for inclusion in the GIS database will be produced under this task. The annual report and coverages will be for the 2001 mapping. Reporting for the 2002 mapping will be in the 2003 budget. The draft progress report and data submittal to the database are due 31 March 2004. Final report is due 1 June 2004.

Budget FY-2003:

Category	Staff-Days	Cost
Personnel:		
Field Mapping & interpretation	58	\$ 29,064
Digitizing & data processing	46	\$ 23,560
Data Analysis	<u>19</u>	\$ 12,100
Subtotal	123	\$ 64,724
Travel/per diem:		
Field Mapping & interpretation	26	\$ 3,250
Digitizing & data processing	<u>0</u>	\$ <u>0</u>
Subtotal	26	\$ 3,250
Equipment Rental (boats, equipment)		\$ 700
Videography flight (USBR)		9,000
Map prints, binders, misc. supplies		\$ 1,200
Overhead (10% of subcontract)		\$ <u>4,213</u>
Grand Total		\$ 83,087

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

Water Temperature Monitoring Fiscal Year 2003 Project Proposal

Principal Investigator: Ron Bliesner
Keller-Bliesner Engineering
78 East Center, Logan, UT 84321
(435) 753-5651 bliesner@kelbli.com

Study Area:

Temperature recorders are installed from RM 224 (Navajo Dam) to RM 92.5 (Montezuma Creek Bridge).

Collections:

None.

Background:

Water temperature recorders were installed in 1992. This work element is a continuation of the original work, with station servicing and data extraction.

Objective:

Collect Water Temperature Data at 7 locations

Methods:

Collect Water Temperature Data at 7 locations. Temperature recorders are located at Navajo Dam, Archuleta, Farmington, Shiprock, Four Corners and Montezuma Creek and on the Animas River at Farmington. These recorders will be serviced twice and the data extracted and plotted for the annual report.

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task. The draft progress report and data submittal to the database are due 31 March 2004. Final report is due 1 June 2004.

Budget FY-2003:

Category	Staff-Days	Cost
Personnel:		
Data Collection	4	\$ 2,580
Data Analysis	<u>6</u>	\$ <u>4,340</u>
Subtotal	10	\$ 6,920
Travel/per diem:	2	\$ 270
Data logging Equipment Rental		\$ 200
Misc. supplies		\$ 300
Overhead (10% of subcontract)		\$ <u>0</u>
Grand Total		\$ 7,690

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

Water Quality Monitoring Fiscal Year 2003 Project Proposal

Principal Investigator: Ron Bliesner
Keller-Bliesner Engineering
78 East Center, Logan, UT 84321
(435) 753-5651 bliesner@kelbli.com

Study Area:

Water samples will be taken at 12 locations along the San Juan River or tributaries between RM 219 (Archuleta) and RM 52 (Mexican Hat).

Collections:

Water samples only

Background:

Monthly water samples during 1991-1998 have been collected at about 30 different sites in the San Juan River and its tributaries within the study area. The results of the water-quality analyses have shown that most concentrations are replicated between months and among nearby stations. The results of these analyses were used to identify the stations, set the timing and parameters of analysis.

Objective:

Collect Quarterly Water Samples at 12 Locations.

Methods:

Collect Quarterly Water Samples at 12 Locations. Depth integrated water samples will be collected at the 12 locations listed in Table 1. Samples will be taken quarterly in February, May, August and November of each year near mid-month. The chemical analyses most relevant to the long-term monitoring goals are listed in Table 2. The concentration of the parameters listed in the first column will be determined every sampling period. In addition field measurements of temperature, pH, redox potential, electrical conductivity and dissolved oxygen will be taken. Annually, during low flow periods in February, the water samples should analyzed for all the parameters listed in Table 2. Field data collection and laboratory analysis will be completed by standard EPA methods, where applicable.

Table 1. Proposed Sampling Stations along San Juan River between Navajo Dam and Mexican Hat.

Station Name	Station ID	USGS Sampling In Period	BIA Sampling Period
SAN JUAN RIVER NR ARCHULETA BRIDGE	9355500	1958-1984	1991-1998
GALLEGOS CANYON NR FARMINGTON, NM	9357255	1979-1981	1991-1998
ANIMAS RIVER AT FARMINGTON, NM	9364500	1958-1992	1991-1998
SAN JUAN RIVER AT FARMINGTON, NM	9365000	1974-1991	1991-1998
LA PLATA RIVER NR FARMINGTON, NM	9367500	1977-1991	1994-1998
OJO AMARILLO CANYON	9367536		1993-1998
SAN JUAN RIVER AT SHIPROCK, NM	9368000	1958-1992	1991-1998
MANCOS RIVER NR FOUR CORNERS	9371005		1991-1998
SAN JUAN RIVER AT FOUR CORNERS, CO	9371010	1977-1990	1991-1998
SAN JUAN RIVER AT MONTEZUMA CREEK BRIDGE	9378610		1991-1998
SAN JUAN RIVER AT BLUFF BRIDGE (HIGHWAY 191)	9379495		1991-1998
SAN JUAN RIVER NR BLUFF, UT (AT MEXICAN HAT)	9379500	1974-1993	1991-1998

Table 2. Water quality parameters for analysis

Quarterly	Annually
Arsenic (total and dissolved)	Aluminum (total and dissolved)
Calcium (dissolved)	Barium (total and dissolved)
Copper (total and dissolved)	Manganese (total and dissolved)
Lead (total and dissolved)	Nickel (total and dissolved)
Magnesium (dissolved)	Potassium (total and dissolved)
Mercury (total and dissolved)	Strontium (total and dissolved)
Sodium (dissolved)	
Selenium (total, dissolved, total recoverable)	
Zinc (total and dissolved)	Chloride (dissolved)
	Ammonia (dissolved)
Alkalinity(HCO_3)	Nitrate (dissolved)
Hardness	Nitrite (dissolved)
TDS	Silica (total and dissolved)
TSS	Sulfate (dissolved)
Turbidity	Orthophosphate (dissolved)

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task. The draft progress report and data submittal to the database are due 31 March 2004. Final report is due 1 June 2004.

Budget FY-2003:

<u>Category</u>	<u>Staff-Days</u>	<u>Cost</u>
Personnel:		
Data collection and analysis	17	\$ 4,887
Travel/per diem:	9	\$ 1,000
Equipment cost (sampling equipment rental)		\$ 900
Laboratory analysis		\$ 19,000
Overhead (10% of subcontract)		\$ <u>1,900</u>
Grand Total		\$ <u>27,687</u>

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

**Polynuclear Aromatic Hydrocarbon (PAH) Study
Fiscal Year 2003 Project Proposal**

Principal Investigator: Dale Wirth
U. S. Bureau of Land Management
1235 La Plata Highway, Suite A
Farmington, New Mexico 87401
(505) 599-6320 dale_wirth@nm.blm.gov

Background

In July of 1991, the Albuquerque District Office of the Bureau of Land Management (BLM) issued a Draft Resource Management Plan Amendment (RMP)/Environmental Impact Statement (EIS) regarding oil and gas leasing in San Juan, McKinley, Sandoval and Rio Arriba Counties. The main land mass affected by the RMP is under the management of the Farmington Field Office (FFO).

July 20, 1993, the United States Fish and Wildlife Service (USFWS) issued a Formal Section 7 Biological Opinion on the RMP/EIS. The Biological Opinion stated that “the ongoing and proposed oil and gas leasing and development activities are likely to jeopardize the continued existence of the Colorado pikeminnow (formerly Colorado squawfish) and the razorback sucker by reducing the likelihood of both the survival and recovery of the species through degradation of the aquatic habitat in the San Juan River”.

In order to define parameters for the study identified in the Reasonable and Prudent Alternative, USFWS and BLM agreed to develop a project that would investigate possible sources of PAHs due to the federal oil and gas-leasing program. These sources include water and sediment from the San Juan, La Plata, and Animas Rivers, ephemeral washes, and discharge pits located on and directly associated with well locations. In addition, BLM and USFWS have agreed to work cooperatively to establish baseline air quality data that addresses possible impacts from the gas and oil production industry under the jurisdiction of the FFO.

The biological opinion that was published July 20, 1993 contained three phases for the PAH study to be conducted by the BLM. Phase I, conducted in 1994, established a baseline data set for the FFO for both streams and ephemeral washes, as well as, well locations in the vulnerable zone and in-stream semi-permeable membrane device placement to determine total cumulative exposures (performed by FWS).

Phase II of the study calls for any identifiable sources to be further investigated and remediated, and for continued monitoring throughout the basin, while Phase III calls for long term monitoring of PAHs throughout the FFO. In actuality, Phases II and III have been integrated and are considered as on-going processes

The major problem concerning the issue of PAH contribution by oil and gas development is the lack of surface water systems data within the Basin, PAH mobility data, a lack of information regarding toxicological effects, and possible PAH contributions from other likely sources within the Basin.

Due to the lack of data concerning the distribution of PAHs, one of the main goals of Phase I was to develop a database identifying the locations of possible sources and occurrences of PAHs. In order to achieve this goal, BLM developed maps of the sample collection locations, as well as an electronic database of all locations, sample types, and concentrations levels. This data is continually refined to include additional data, sample location data, newly collected analytical data, and other information that may be pertinent to evaluating the PAHs found.

The goals of Phase II and III focused on the locations that demonstrated measurable levels of PAHs and to try to determine if chemical migration was occurring from the locations. River monitoring was increased to both spring and fall to determine seasonal effects of high flows associated with spring run-off and low flows associated with the cessation of irrigation return flows in the fall.

BLM's data collection activities included surface run-off and oil and gas well locations located in the focused vulnerable area because of the concern that PAHs may be discharged to the surface water system via unlined pits associated with production activities. Types of waste discharges that are collected in pits in the basin include: condensate from pipeline drip, separator discharges, dehydrator drip, and brine water collection. The State of New Mexico Oil Conservation Commission initiated regulations for pit closures in 1988. Following the Oil Conservation Commissions pit closure regulations, the BLM implemented a pit remediation program designed to clean up potential groundwater contamination sources and replace the unlined pits with lined pits and/or tanks to prevent further releases on federal leases. BLM's pit remediation program has been successful in the elimination of waste discharges into unlined pits located within and outside the focused vulnerable area.

Sampling of well locations included collecting a sample from within the pit, and another sample off-site and hydrologically down gradient. Samples were collected with an Oakfield stainless steel soil core sampler. The sampling depths varied depending on the accessibility to the pit, as well as sediment compaction. Generally, sample depths in the pits ranged from two to three feet while those collected down gradient were collected at a shallower depth of one to two feet.

Ephemeral streams were sampled throughout the basin in order to determine migration of PAHs via the ephemeral drainage system. Soil moisture was encountered from one inch to over two feet, depending on the size and location of the stream bed. Sample collection was done with an auger and core sampler similar to the well location samples. Depth for sample collection in the ephemeral streams ranged from six inches to two and one half feet.

Water and sediment samples were collected in twenty-five locations throughout the San Juan River Basin. Locations were chosen based on possible drainage and contaminant loading sources such as municipal discharges, industrial discharges, large ephemeral stream drainages and known agricultural return flow locations. In 1998, sample locations were expanded from twenty five to twenty seven locations. Water samples were collected in the water column by cross sectional and vertical stratification in two liter brown glass bottles at each location. Sediment samples were collected with a Weldco Hand Core Sediment Sampler to an average depth of two to six inches.

Air monitoring was conducted at ten deployment locations in the summer of 1998. Five locations were identified in upland areas and five were identified along river tracts. Each deployment site consisted of three semi-permeable membrane devices (SPMDs): site blank, exposure to direct sunlight, and canopy or shaded cover exposure for a total of 30 SPMD's. The locations selected were

developed in conjunction with the USFWS, and will provide information not only within the San Juan Basin, but will also provide information on PAHs that might be carried into the basin by prevailing winds. The air monitoring data will provide empirical data and will not provide data on air source locations.

The samples collected (air, water, and sediment) were analyzed by Quanterra Labs (now Severn Trent Laboratories, Inc, [STL]) in Denver, Colorado using EPA method 8310 for soil and water and EPA method 8270 for air. Detection limits in ug/kg and u/l were as follows:

PAH	Soils	Water
Napthalene	200	0.95
Acenaphthylene	200	0.95
Acenaphthene	200	0.95
Fluorene	40	0.19
Phenanthrene	40	0.19
Anthracene	20	0.095
Fluoranthene	40	0.19
Pyrene	40	0.19
Benzo (a) anthracene	20	0.095
Chrysene	40	0.19
Benzo (b) fluoranthene	20	0.095
Benzo (k) fluoranthene	20	0.095
Benzo (a) pyrene	20	0.095
Dibenz (a,h) anthracene	40	0.19
Benzo (g,h,I) perylene	40	0.19
Indeno (1,2,0-cd) pyrene	40	0.19

Soil and water samples were collected and stored on ice in the field. The samples are transferred to a refrigerator at the FFO. All samples were shipped within 48 hours of collection. The samples were packed in cooler with ice and shipped to the Quanterra Lab overnight. Data reports were submitted directly to BLM along with an electronic copy.

Objective

Preliminary conclusions, based on the soil and water data collected over the past seven years in the San Juan Basin suggests that the oil and gas leasing program is not contributing PAHs to the

Colorado pikeminnow and razorback sucker habitat via surface run-off. Airborne contamination study results conducted in 1999 suggested that the biological effect of airborne PAHs on the aquatic ecosystem in the San Juan Basin is minimal.

The sediment and water sampling program has been relatively ineffective. Reasons for this may be attributed to the short life of PAHs, which are quickly partitioned either to sediment or biota, sediment cycling and removal, the complete absence of PAHs from the San Juan or Animas Rivers, or a combination of all these factors. Upon review of the water and sediment data, discussions and e-mail correspondences between the BLM and the USFWS Ecological Services Field Office, in Albuquerque, New Mexico were undertaken during June and July of 1999. A consensus was reached that additional monitoring of river water might not be as effective in determining major routes of PAH transport as would other methods, namely storm water collection and additional air monitoring.

Therefore, as a result of discussions and correspondence with the USFWS in 1999 the BLM will be continuing the Phase III long term monitoring for PAHs by collecting storm water runoff. Air monitoring obligations, as outlined in the Biological Opinion have been fulfilled and will not be undertaken for fiscal year (FY) 2002.

Method

Efforts will be made to obtain storm water samples for the identified drainages. However, discretion and flexibility will be exercised by BLM to substitute an alternate drainage in the immediate area in the event that identified drainage can not be sampled or fails to experience a storm water flow event. The five ephemeral tributaries include Canyon Largo, Gobernador Canyon, Shumway Canyon, contributing to the San Juan River and Ditch Canyon and Bohanon Canyon contributing to the Animas River. Water samples will be collected in two liter brown glass bottles at each location, stored on ice and shipped within 48 hours for analysis.

Products:

Preparation of a FY 2001 annual report will be forth coming. Preparation of an annual report and electronic data files for upcoming FY 2002 storm water sampling program is anticipated for the spring of 2003.

Budget FY-02:

Labor	\$	10,000
Travel	\$	2,000
Vehicle	\$	1,000
Supplies	\$	2,000
Overhead	\$	5,000
Procurement	\$	30,000
TOTAL	\$	50,000

**Update and Maintenance of San Juan River Recovery Implementation Program GIS
Database and Development of a Web-based Interactive Interface
Fiscal Year 2003 Project Proposal**

Principal Investigators: Sara J. Gottlieb and Alexandra M. Snyder
Division of Fishes - Museum of Southwestern Biology
University of New Mexico,
Albuquerque, NM 87131
(505) 277-6005
gottlieb@unm.edu
amsnyder@unm.edu

Background

San Juan River research efforts that preceded the establishment of the San Juan River Recovery Implementation Program, in combination with those that have subsequently resulted from that program, form the basis of the suite of decisions already made and those to be made regarding biologic and hydrologic issues. An immense amount of information has been gathered through the San Juan River research activities that have been conducted over the last 15 years. Most of this information has been synthesized and made available in the form of reports or publications. For example, in 1999 and 2000 researchers consolidated and analyzed data from their individual long-term research projects and presented it as summary reports of seven years of research (1991-1998). Likewise, the flow recommendation report released in 1999 represented a synthesis between biological, hydrological, and habitat research activities.

Preparation of the aforementioned summary reports was facilitated by the existence of the San Juan River Recovery Implementation Program database. Individual researchers are responsible for submitting raw data for incorporation to the integrated database. This project was both initiated and maintained by Keller-Bliesner Engineering, LLC (Keller-Bliesner) in Logan, Utah in cooperation with the U.S. Fish and Wildlife Service's - Region 2 Albuquerque Office. Keller-Bliesner provided coordination of updates, maintenance, and distribution (via CD's) of the database.

There have been numerous important advances during the past five-years in GIS and database arenas that now allow for expansion of the electronic capabilities of the database and its associated information. Since many current San Juan River researchers do not have the expertise needed to use the GIS database in its present format, increase in the ease of use was identified as a principal need for future versions of the database. This modification is necessary to make the information available to more researchers within the program. Development of a user-friendly, web-based interface will decrease the time between distribution of updated versions of the database and enable researchers to access their own and other researchers' data in their analyses and reports.

Another important objective of this proposal is to provide for the generation of distribution maps that result from user-initiated queries. In 2000, an unfunded pilot project was undertaken (using exclusively San Juan River larval Colorado pikeminnow project data) whose goal was to provide a web-based interactive GIS query database (see: http://msb-fish.unm.edu/ArcIMS/Website/SJR_Test/index.htm). The results of this initial effort were well received, demonstrated the utility of such an effort, and fulfilled multiple project needs.

This proposal represents a shift in the objects of the database management project and will require several years to be fully realized. The purpose of this proposal is to seek funding to continue this effort with the goal of developing a (very) user-friendly web-based interface to San Juan River Recovery Implementation Program's GIS Database. In addition, continuation of funds to cover the cost of maintenance and distribution of the database are being requested.

The original proposal submitted to the San Juan River Biology Committee (SJRBC) anticipated a multi-step process to this work in which recent (2001-2002) data would have been used to develop a prototype database and interface (FY2003). The following year (FY 2004) would have been used to implement changes to the prototype that had been suggested by the SJRBC and incorporate upgrades, and process all geo-referenced data. The following two years (FY 2005 and FY 2006) would have involved the incorporation of all non-geo-referenced data. The transition phase from development to maintenance was to occur in FY 2007.

Upon review and request of the SJRBC, we have restructured the funding structure of the proposal so that between 75-90% of the work can be accomplished during year 1 (FY 2003). Year 2 (FY 2004) of the project will be devoted to making changes to the prototype and incorporation any remaining non-geo-referenced data. Year 3 (FY 2005) is now designed as transition period during which the project will no longer be in development but instead have as its primary tasks annual updates and regular maintenance.

Keller-Bliesner tasks and budget costs for facilitation of the transfer (year 1 of this project) are included in this proposal.

Study Area:

This project will initially encompass the San Juan River Basin downstream of Navajo Reservoir but should ultimately be expanded to include the entire San Juan River Basin.

Objectives (to be initiated in FY2003, with completion projected for out years):

- Develop a web-based interface to the San Juan River Recovery Implementation Program's GIS Database.
- Maintain, annually update, and distribute current San Juan River Recovery Implementation Program GIS researcher database using appropriate format.

- Establish electronic archives of the aforementioned database at the ultimate repository for this information (U.S. Fish and Wildlife Service Region 2 Office, Albuquerque, New Mexico).

Methods:

- Develop a web-based interface to the GIS Database.
The San Juan River 2000 Larval Colorado pikeminnow Survey Data prototype web page (http://msb-fish.unm.edu/ArcIMS/Website/SJR_Test/index.htm) will serve as a foundation for the design of an interface which authorized researchers can use to access and analyze the data geographically. The interface will provide the ability to create custom multiple-parameter queries within the researchers' datasets and result in generation of maps and data reports that can be used in analysis as well as reporting activities.
- Update and Maintain GIS Database.
Transfer the existing GIS Database, which has been maintained by Keller-Bliesner since its inception, to MSB/USFWS. Modify the database format (under consultation and coordination with Keller-Bliesner) if necessary to better integrate with the data program being prepared for GIS interface application. Assume responsibility for tracking (reminding) and acquisition of annual datasets to be submitted by 31 March of each year by individual researchers. Provide seamless incorporation of new data with the existing San Juan River Recovery Implementation Program's GIS Database.
- Coordinate Database Updates and Maintenance with FWS-Region 2. The close proximity of MSB to the U.S. Fish and Wildlife Service's - Region 2 Albuquerque Office provides for extensive coordination of updates, maintenance, and development of the database. The MSB staff will consult and coordinate closely with appropriate staff (including the San Juan River Program Coordinator and San Juan River Program Assistant) in the FWS-Region 2 office in all aspects of the work. This effort will result in the collaborative production of the database and web-based interface.
- Contact and coordinate with appropriate personnel in the Upper Colorado River Basin and Glen Canyon Environmental Studies offices to investigate the feasibility of linkage of the proposed San Juan River Recovery Implementation Database with other regional fish databases.

Products:

The database and associated documentation will be disseminated via a password-protected project web page. The database and interface will reside with Region 2 (Albuquerque) of the U.S. Fish and Wildlife Service, the designated repository for the data, and on a MSB server. A draft report that describes the results and progress of the FY

2003 efforts will be distributed by 31 March 2004. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2004.

Budget FY-2003

Personnel	
Database Manager (80 staff-days) programming, data compilation, data management, supervision)	\$ 40,000
Database Technician (80 staff-days) (data entry, data query)	\$ 20,000
Programming Consultation (20 staff-days) (provide assistance with complex programming)	\$ 10,000
Subtotal	\$ 70,000
Travel and per diem	
Travel (mileage – attend two SJR meetings)	\$ 500
Per diem (6 staff-days)	\$ 500
Subtotal	\$ 1,000
Equipment and Supplies	
Laboratory Equipment/supplies (CD's, office supplies)	\$ 5,000
Computer supplies/maintenance (hardware and software upgrades)	\$ 5,000
Subtotal	\$ 10,000
Total	\$ 81,000
Administrative Overhead	\$ 12,150
TOTAL (UNM)	\$ 93,150
TOTAL (Keller-Bliesner-detailed below)	\$ 9,600
GRAND TOTAL	\$102,750

Out-year funding (based on 5% increases):

Fiscal Year 2004 \$ 48,000 Fiscal Year 2005 * \$ * 39,280

The anticipated reduction in cost reflects completion of interactive database portion of the study and reflects a change in duties to that primarily of database management.

Objective (Keller-Bliesner):

Coordinate with UNM for the transfer of the database maintenance task to a web-based operation.

Methods (Keller-Bliesner):

- 1.) Prepare all data sets for transfer to UNM. All data sets now included in the database will be prepared for transfer to UNM, including metadata files and all products sent by individual contributors.
- 2.) Provide support in conversion to Web-based database. Support will be provided to UNM in understanding database construction, resolving problems and answering questions in the process of the transfer.

Products (Keller-Bliesner):

The production of the web-based database will be assisted by this activity. No actual deliverable is included.

Budget FY-2002(Keller-Bliesner):

Category	Staff-Days		Cost
Personnel:			
Prepare data sets for transfer	5	\$	3,000
Support UNM in the transfer process	<u>10</u>	\$	<u>6,000</u>
Subtotal	15	\$	9,000
Travel/per diem:	0	\$	0
Equipment Rental (boats, equipment)		\$	0
CD's, copies, misc. supplies		\$	500
Overhead (10% of subcontract)		\$	<u>100</u>
Grand Total		\$	<u>9,600</u>

There is no out-year funding for this task.

Summary of Monitoring Activities for 1999-2001

Principal Investigator: Paul Holden

Jicarilla Apache Nation

BIO-WEST, Inc.

1063 W. 1400 N.

Logan, UT 84321

435-752-4202

pholden@bio-west.com

Background:

The San Juan River Monitoring Plan and Protocols calls for annual summaries of monitoring activities for all nine of the major monitoring activities (larval fish, small bodied fish, large bodied fish, channel morphology, cobble bars, backwater/low velocity habitat, habitat mapping, water temperature, and water quality). Reports vary in length from a few pages for activities such as temperature monitoring, to over 50 pages with many graphs for the adult fish monitoring. In addition, monitoring activities are being summarized for the first three years of monitoring (1999-2001), and in many cases will be compared with data collected during the 7-year research period (1991-1998). Hence, monitoring reports being prepared in 2002 may total 200 or more pages and include many individual analyses with graphs and accompanying tables.

During a Biological Subcommittee meeting held in Albuquerque on September 4 and 5, 2002, the subcommittee concluded that there was a need for someone to provide a summary of the individual monitoring reports so those not interested in wading through the entire stack of individual reports could still understand what was found in the first 3 years of monitoring. This scope of work proposes to develop a summary of the first three years of monitoring activities so the results can be more readily understood by Program participants and the general public.

Goal:

The goal of this scope of work is to prepare a summary for the 1999-2001 monitoring activities.

Methods:

Individual monitoring reports are due in late 2002 that will summarize the first three years of monitoring. Reports for physical studies may be later due to contracting problems. The reports will be reviewed and the most important information from each report will be used to develop a summary document. The document will concentrate on what was found for each monitoring activity and how they relate, based on the analyses in each monitoring report. In addition, flows from San Juan River gages will also be presented. No new analyses will be performed but an attempt will be made to provide the reader with a clear understanding of what was found and

what the various authors concluded from their studies based on a synthesis of all the reports and the goals of the monitoring activities as set forth in the Monitoring Plan.

A draft summary will be prepared 45 days following the completion of individual monitoring reports and provided to the Biology Committee and Hydrology Committee for review. Following a 15 day review period and a conference call, if necessary, final revisions will be made and the report will be finalized. The final report will include the summary, with the individual monitoring reports as appendices. An electronic copy will be provided to the Program Manager for distribution to the various SJRIP committees and interested publics.

Products:

A monitoring report that includes a summary plus individual monitoring reports.

Budget:

Personnel (250 man hrs.)	\$14,000
Misc. supplies, copies, etc.	<u>1,000</u>
Total	\$15,000